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Identifying Patterns

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*Identifying the The Ideal Way of Practicing Science*

According to a common saying: “Practice makes perfect.” However, the manner by which to achieve practice is left up to lose interpretation. Is it best to dive right into the actual process, or rather build a foundation through monotonous textbook learning that will gradually lead to this very same point? This is the dilemma that faces prospective scientists and those who teach them. While it may seem beneficial to capture the students interests by immediately delving into the real-life application of science rather than the textbook's take on it, this approach is not always practical. In some subjects, there are very few if any restrictions to applied learning, making it a more feasible option than the textbook. Therefore, the decision of which path to pursue is left up to the discretion of the teacher and student. Unlike these areas, science can be both costly and dangerous, which makes it less than ideal for classroom teaching especially at the elementary level. For this reason, many schools prefer to use the more gradual, albeit dry, approach to ease into the subject in order to dilute the negative effects. By not wasting or misusing materials the cost incurred by the less frequently conducted experiments can be more easily justified, and by going into the process with prior knowledge the risk of injury or damage is minimized. While some people are intrigued by science in practice and its application to the real world, they are deterred from pursuing career paths in the field due to the dryness of modern textbook readings on which they are introduced to the subjects. Each method contains both positive and negative aspects, yet it is necessary to reach a happy medium that will

simultaneously maintain the students interest and ensure that they are learning. If these two methods can combine with one another to form one ideal method then it may spark interest for younger generations and lead them to pursue a career in the realm of science, rather than causing them to lose interest and seek out other career opportunities.

Professor Anybody and Professor Particular are polar opposite representations of each other on the spectrum of scientific research. Through textbooks and research publications Professor Anybody using objectivity and logic. Textbooks rely on a matter-of-fact approach, while Professor Particular and applied science tends to be more subjective. While textbooks are used to prepare people for everyday practice, they tend to avoid directly talking about everyday practice and usually contain an abbreviated and less detailed interpretation or summary of the information.

My High school Geometry class closely parallels this disconnect between the textbooks and everyday practice. When thinking back on my freshman geometry class one of the first few parts of the class that come to mind are the proofs. Through proofs students gain knowledge, but lose interest. While it may be fulfilling to understand the process of finding out mathematical problems through proofs, writing them down can be a tedious and trying task. Proofs are a staple of Geometry, and although they caused me much distress in high school, they allowed me to master the geometric rules and provided me with a better understanding of the information. They require students to be meticulous, with their step-by-step approach. This leads to an increased overall understanding of the material, because in order to reach the final answer it is necessary to understand each of the previous steps. While this was helpful when solving the proof it was a hinderance when it comes to recording the answer. They lead to careless mistakes on technicalities like writing down the step names and remember them in the proper order.

While proofs have their cons, they I realize that they are affective in ensuring that students avoid careless mistakes and happy medium between the textbook work and experimental work.

The strengths of the research articles are the weaknesses of the textbooks, and if their positive aspects could be combined and their negatives eliminated, it would make for an ideal means to communicate information. The research articles give a basic outline as to the central ideas of a particular subject for those who are already familiar with the topic; however, they do not provide sufficient information for those who lack background knowledge on the subject. While they are a good supplement to the experiment itself the research papers do not have enough information on how the scientists drew their conclusions, because they are ineffective in absence of the experiment: "...A research paper converts the process of discovery into an announcement of the discovery. In a sense, the paper itself becomes the discovery claim. Rather than discoverers, researchers become reporters of discoveries." (8). Research articles should provide more detail and give an explanation as to how and why they obtained the information, rather than just stating what conclusions were reached. Research articles usually pertain to just one topic as opposed to the textbook which generally contains information on a wide array of topics. Textbooks contain a vast amount of material and contain a wide amount of subject matter while research paper hone in on specific topics and this lends itself to independent thought. Research papers allow you to add your own opinion and then add information to prove or diss-prove if you are correct. Textbooks draw upon numerous sources of information from a wide landscape of different avenues. They do not require approval from the scientific community. On the other hand, research papers tend to have more adversity in validating thoughts. Research papers require the author to get his or her ideas credited before the public eye. However, textbooks need to maintain objectivity and an unbiased perspective. They provide too much

“fluff” and do not get down to the bare essentials. Statistics and mathematics in general relies on the memorization and application of formulas. Statistics is in line with the textbook, rather than the research paper, style of conveying information.

Statistics is based more in the credibility side than the discovery one. Credibility is the interflow of ideas between a research community and individual scientists and relies more on data and tangible information than discovery, which lends itself to the intangible aspects of the world to be studied. Scientists, like statisticians, rely on both discovery and credibility: “I place the individual scientist in the center. She engages in two conversations, one with the world to be studied, and the other with other members of the research community” (4). Research and data is like the rotational axis on which the world of statistics revolves and the exchange of this information is essential to its existence. On the credibility side of the diagram, the scientific community takes ideas and subsequent scientists continually build upon them. The greatest way in which statistics relates to discovery is when statisticians use the discovered results of an experiment on the world to be studied and analyze them in order to test their validity and communicate this to the research community. This process of convincing others that these results are accurate is actually related to credibility: “...trying to convince others that new findings are correct” (5). The mathematical techniques are used as a means to establish one's findings. In statistics just like in the circle of credibility after researchers conduct a randomized controlled experiment or an observational one, they must analyze their conclusions and try to convince others that these conclusions are valid. In statistics, the validity of experiments can be diss-proven by confounding factors, or proven if their experiments are conducted in a randomized controlled and double-blind manner. Statistics contains aspects of both discovery and credibility because they conduct experiments, which is the discovery side of science and

then they must persuade others that these conclusions are accurate which is an example of the credibility side.

Neither the textbook method nor the everyday practice of science is ideal, however when the positive aspects of these two methods are combined it creates a happy medium between the two. The fusion of verbal theory and physical practice are both necessary to make sure that everything is conveyed in an accurate manner. In order to both keep the students interested and ensure that it is done in an efficient and relatively inexpensive manner it requires applied learning such as experiments, but also background information on the experiments in order to efficiently utilize resources. You cannot conduct labs without a general background knowledge of the topics, and conversely you cannot amass knowledge without ever applying it to the subject at hand. The common thread that unites all of these ideas is that there must be a combination of the two extremes in order to reach and ideal situation. Statistics is not just credibility or discovery, but a mix between the two. While the experiments represent the discovery side of practicing science convincing others that they are valid represents the credibility side. You cannot establish something as true unless you have conducted actual experiments before you reach conclusion whether that is in accordance with what you hypothesized or contradictory. Once this is achieved you can reach the conclusion and convince others that it is correct. Credibility serves as a gateway through which you have the right to conduct further discovery, if there is no credibility then others will not invest their time and money in these attempts at reaching discoveries. You need a display of credibility in addition to the discovery. Without sustaining a credible position you use support and backing by others, which prevents you from other discoveries. You want some results that will both advance your personal career and the well-being of science in general. There must be an execution of the physical task at hand and

expression of these ideas in a written form but too much of either of these can prove ineffective.